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MECHANICALLY REGULATED TIME INDICATOR

The present invention relates to a mechanically regulated time indicator according to the definition of the Claims. This time indicator is particularly suited for use in wrist-watches.

The present invention falls into the family of so-called tourbillon time indicators. The conventional type of such a time indicator is represented by the Bréguet Tourbillon from 1795. In this device, a balance, its spiral spring and its escapement are assembled in the interior of a turning cage, the rotational speed of which is one revolution per 60 seconds. The cage turns about a double bearing gear.

In the development of wristwatches, a reduction in the number of bearings is observed. The patent GB-21421 from 1892 describes a tourbillon cantilevered in a single large bearing. Patent CH-353679 from 1961 describes a cantilevered bearing construction of the ball bearing type wherein the ball bearing replaces the thick smooth bearing used up to that time. Nowadays, cantilevered bearings of the ball bearing type are widely used, exemplified by the constructions in accordance with patent US-4132061 from 1977.

The speed of rotation can be less than 60 sec. per revolution as is shown by the tourbillon of Albert H. Potter published in the work "Horlogerie Ancienne" no. 22, 2nd semester 1987, pages 64-71.

Since then, numerous variations in construction have been reported. The work "Das Tourbillon" by Reinhard Meis, Callway Verlag München, 2<sup>nd</sup> Ed., 1993, provides a very good overview of the subject. Thus, one can differentiate tourbillons mounted in a non-visible or a visible fashion, as seen from the side of the dial. To be non-visible, a tourbillon is mounted with its base on the dial side. To be visible, a tourbillon is mounted with a bridge on the dial side.

Often, the tourbillons are arranged in the six o'clock, twelve o'clock positions on the dial or in the middle of the dial. Such creations of tourbillons arranged in the six o'clock or twelve o'clock positions are shown in the work "Das Tourbillon" by Reinhard Meis, Callway Verlag München, 2<sup>nd</sup> Ed., 1993. The creation in the middle of the dial implies that the tourbillon is mounted on the central staff of the time indicator, resulting in a relatively thick construction.

A particularly aesthetic tourbillon is known by the name flying tourbillon. Such a flying tourbillon is described, for example, in the work "Drehganguhren" by Alfred Helwig, Verlag der Deutschen Uhrmacher-Zeitung, Berlin, 1927. This flying tourbillon has no component that covers the cage. Another flying tourbillon, visible from the dial side and projecting beyond the movement is reported in the work "Faszination der Uhrentechnik" by Reinhard Meis, page 276, Laterna magica.

All these tourbillon constructions are known to present the disadvantage of being understood as components, which are indissociable from the watch movement. This makes their final adjustment tricky and their customisation (decoration, design, frequency) if not impossible, then certainly difficult.

An object of the present invention is to provide an astute construction of a time indicator of the balance spring flying tourbillon type visible from the dial side. A further object of the invention is to provide a solution to the above-mentioned disadvantage and to describe an economical and flexible process for the assembly and /or adjustment of watches. A final object of the invention is to provide a particularly aesthetic and slim time indicator for wristwatches.

The object is provided by the invention as defined by the Claims.

The present invention relates to a time indicator of the balance spring flying tourbillon type. This flying tourbillon is visible from the dial side and comprises a balance bridge forming a cage with a collet. Its cantilevered single bearing supports the said

flying tourbillon assembly. The cantilevered single bearing is of the ball bearing type. The flying tourbillon assembly is designed as an independent tourbillon module, visible from the dial side of the movement and separable from the other side of the movement. All the components can be assembled together and adjusted independently from the movement.

Compared with a conventional mechanically regulated time indicator of the balance spring tourbillon type, the invention presents the following advantages:

- The time indicator is provided with a cantilevered bearing of the ball bearing type thus permitting a particularly simple and robust construction that requires fewer components.
- The time indicator is mounted in such a way that it is visible from the dial side and has no part overlapping the cage. This enables a particularly aesthetic, easily obtainable and slim construction. This construction is adapted for large and small calibres.
- The time indicator includes an assembly of a tourbillon collet, a balance bridge, cannon, ball bearing and a tourbillon bridge forming a tourbillon module supporting the regulatory organs, that is the oscillating balance and balance spring with pallet, pallet wheel and pinion and interior-toothed crown. The whole is fully separable from the movement, has the advantage that it can be assembled by itself and be adjusted outside the movement. This tourbillon module is independent from the movement in so far as the frequency, the finish or the adjustment are concerned.
- In a preferred embodiment the balance bridge itself serves as an indicator by its shape and/or decoration. Such a balance bridge can be created in a material so as to permit maximum visibility of the moving parts. Such a bridge is, for example, of a transparent or semi transparent nature, disposed with precious stones and/or precious metals and/or ornaments as indicator.

The invention will be described in more detail with the help of the following figures in which:

- Fig. 1 is a cross-sectional view of a tourbillon regulated time indicator,
- Fig. 2 is a cross-sectional side view of the detail of an exemplary embodiment of a regulated time indicator according to the invention,
- Fig. 3 is a top view of the detail of an exemplary embodiment of a regulated time indicator according to fig. 2.
- Fig. 4 is a perspective view of a tourbillon module for a time indicator according to the invention.
- Fig. 5 is a view of the rear side of a movement carrying the tourbillon module according to fig. 4.
- Fig. 6 is a cross-sectional view of the detail along the line D-D of fig. 5.

Fig. 1 is a cross-sectional view of a balance spring tourbillon regulated time indicator. In this device, a balance, its spiral spring and the tourbillon collet are assembled inside a turning cage that rotates at a speed of 60 sec. per revolution. The whole cage turns around a double bearing gear.

Figures 2 and 3 are different views of detail of the exemplary embodiments of a regulated time indicator according to the invention. Fig. 2 is a cross-sectional view from the side and Fig. 3 is a view from above.

This exemplary embodiment of a balance spring type time indicator refers to a flying tourbillon. It comprises a conventional oscillator with balance, balance-spring and es-

capement. It functions, for illustrative purposes, with a Swiss pallet escapement. This exemplary embodiment is by no means limiting. A person having ordinary skill in the art, on learning the present invention can create a flying tourbillon with another escapement system, for example a check or detent escapement system or with another known regulating system.

This oscillator is mounted in the interior of a tourbillon cage. The tourbillon cage turns about a bearing. The tourbillon is visible from the dial side 15. In particular, on the dial side 15, the tourbillon cage is formed by a balance bridge attached to a tourbillon collet 1 by the pillars 3. Thus the flying tourbillon is entirely visible and has no parts that overlap the cage.

The single bearing is a cantilever ball bearing construction. On the bottom side the cannon 4 is held axially in the ball bearing 5 that enables it to turn freely. This ball bearing 5 is attached by an external ring to a tourbillon bridge 6.

The tourbillon collet 1 is the part with the greatest diameter and thus defines the space required in the plane of the watch. This tourbillon collet accepts the tothing that engages with a last wheel 12 of a movement 13. The oscillator is maintained by a shaft 7 having a first extremity 9 driven into a cannon 4 attached to the collet 1 and a second extremity 8 driven into the balance bridge 2. These extremities can include anti-shock units. The movement of the Swiss pallet type oscillator is maintained by a pallet and a pallet wheel borne by the tourbillon collet 1. The pallet and pallet wheel, borne by the tourbillon collet 1 turn with the tourbillon collet 1 about the axis of the latter. The pallet wheel is disposed with a pinion 10, which engages with an internal toothed crown 11 attached to the tourbillon bridge 6, thereby creating the rotation of the pallet wheel 10 about its own axis by the motion of the tourbillon collet 1.

According to the exemplary embodiment, the balance is centred with respect to the single bearing. This exemplary embodiment is by no means limiting. A person skilled in the art and knowing the present invention can create a flying tourbillon with a balance eccentrically arranged inside the tourbillon cage.

The assembly tourbillon collet 1, the balance bridge 2, cannon 4, ball bearing type bearing 5 and the tourbillon bridge 6 form an integral module that supports the regulatory organs, that is the balance spring oscillator with pallets, pallet wheel and pinion 10 and internal toothed crown 11. The whole is a tourbillon module that is completely detachable from the movement 13.

The tourbillon module has the advantage that it can be assembled by itself and adjusted outside the movement. This tourbillon module is independent from the movement 13 in so far as the frequency, decoration or adjustment are concerned. A movement 13 can be fitted with tourbillon modules of different frequencies and/or different aesthetic creation. This results in the assembly and maintenance of such a tourbillon module being particularly easy, fast, economical and flexible. In particular, this tourbillon module can be mounted into the watch at the last moment. Thus, it is possible to have a relatively small stock of tourbillon modules and be able to satisfy customers' wishes in a flexible manner, enabling customisation of the watch.

Advantageously, the flying tourbillon according to the invention is arranged in the plane of the dial 15 of a watch or wristwatch in such a way that it is visible from the dial side in the six o'clock or twelve o'clock position. Due to its small thickness, this flying tourbillon can be arranged in the movement 13 in a raised manner with respect to the dial, making the tourbillon and its parts particularly well visible. An indicator hand can be fixed to the balance bridge 2, for example a indicator 14 for a small second hand.

In addition and in place and instead of a second hand, the balance bridge 2 can itself serve as an indicator by means of its shape and/or by an associated decoration. For this, the balance bridge is, for example, created transparent or semi transparent. It can be disposed with precious stones and/or precious metals and/or ornamentations as indicators. A person skilled in the art and knowing the present invention can create other examples of such indicators.

This tourbillon is visible from the dial side 15. The total height of the tourbillon module can vary so as to bring the surface of the tourbillon higher than that of the dial 15 but still below the sweep of the minute and hour hands 16,17.

The compatibility between a family of movements and a family of tourbillon modules is assured by means of an interface, thereby ensuring an interchangeability of the tourbillon modules. The interfacial element ensures that the tourbillon collet 1 maintains a characteristic speed of rotation, for example 60 sec. per revolution. This is provided by an interfacial element, for example by the geometry of its tothing, by the number of teeth, by the shape and positions of the teeth in the movement 13 so as to interlock perfectly with the last wheel 12 of the movement 13. The demultiplication ratio can be adjusted such that interchangeability can be ensured. If for example, the oscillator frequency is reduced by a factor, then the original ratio of the diameter of the pinion 10 and the internal toothed crown 11 must increase by the same factor.

Figures 4, 5 and 6 illustrate in more detail the modularity of the tourbillon of the time indicator according to the invention.

Fig.4 is a schematic perspective view of an exemplary embodiment of a flying tourbillon module 20 for a time indicator according to the invention. The tourbillon is, in principle, the same as that already shown in Figures 2 and 3. It comprises a balance 21 mounted on a shaft 7 with a first extremity 9 and a second extremity 8, a spring 22, a tourbillon collet 1, pillars 3, a balance bridge 2, a cannon 4, an internal toothed crown 11, a ball bearing type bearing 5 and a pinion 10. The tourbillon is mounted on a tourbillon bridge 6. In this device the balance 21, its balance spring 22 and the tourbillon collet 1 are assembled in the interior of a turning cage formed by the pillars 3, the balance bridge 2 and the tourbillon collet 1.

Fig. 5 is a view from the bottom or back (side opposite to the dial side) of a movement 13 with a tourbillon module 20 as illustrated in Fig. 4 and which is mounted on the movement 13. The tourbillon module or rather the tourbillon bridge 6 is fixed onto the bottom side of movement 13 by screws 24. Thus to separate the tourbillon module 20

from the movement 13, one only needs to unscrew the screws 24 and remove the module 20 from the movement 13.

The tourbillon collet 1 receives the toothing engaging with a last wheel (not shown) arranged in a recess 12 of the movement 13.

Fig. 6 is a cross-sectional view of the detail along the line D-D of Fig. 5 and resembles Fig. 2 but shows more clearly the modularity of the tourbillon and its extension into the movement 13. The tourbillon bridge 6 is fixed on the bottom side or back of the movement 13 and the tourbillon module 20 extends into an opening 18 of the movement 13 up to the dial side 15 of the latter.

The ball bearing type bearing 5 is not arranged on the same level as the first extremity 9 of the staff 7 (as illustrated in Fig. 2) but is distanced from this first extremity 9 of this staff 7 towards the level of the centre of gravity of the rotating module. This position of the bearing, as close as possible to the centre of gravity, renders the arrangement more resistant to shocks.

Fig. 6 clearly shows that to detach the tourbillon module 20 from the movement 13, no other component need be removed. Thus the assembly and maintenance of such a tourbillon module is particularly easy, rapid, economical and flexible. In particular, this tourbillon module can be mounted in the watch at the last minute. That means that the movement 13 and the tourbillon module can be manufactured and assembled completely independently. Thus it is possible to have a relatively small stock of tourbillon modules and be able to satisfy the customers' wishes in a flexible manner enabling customisation of the watch. If servicing work is required, the whole movement does not need to be disassembled to gain access to the tourbillon, nor does the case need to be separated from the movement. Although the tourbillon is visible from the dial side, to remove it one only needs to open the watch from the back, unscrew the module and withdraw the module from the movement.



## (Replacement Sheet)

## CLAIMS

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1. Time indicator of the balance spring flying tourbillon type, said flying tourbillon being visible from the dial side (15) of a movement (13) characterized in that the said time indicator of the balance spring flying tourbillon type is designed as an independent tourbillon module (20) that is separable from the movement (13) from the back side.
2. Time indicator according to Claim 1, characterized in that the tourbillon module (20) consists of a tourbillon collet (1), a balance bridge (2), a cannon (4), a ball bearing type bearing (5) and a tourbillon bridge (6) form an integral module supporting the regulatory organs (10, 11, 21).
3. Time indicator according to Claim 1 or 2, characterized in that the tourbillon collet (1) is the part with the greatest diameter, defining the space requirement in the plane of the watch.
4. Time indicator according to one of the Claims 1 to 3, characterized in that the balance is arranged off-centre in the interior of a tourbillon cage.
5. Time indicator according to one of the Claims 1 to 4, characterized in that the oscillator is maintained by a shaft (7) having a first extremity (9) driven into a cannon (4) fixed to the collet (1) and a second extremity (8) driven into the balance bridge (2).
6. Time indicator according to Claim 5, characterized in that the ball bearing type bearing (5) is arranged in a plane between the plane of the said first extremity (9) and the plane of the centre of gravity of the rotatable module.
7. Time indicator according to Claim 5 or 6, characterized in that the extremities (8,9) include shock absorbers.

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8. Time indicator according to one of the Claims 1 to 7, characterized in that the tourbillon bridge (6) is shaped in such a way that it is attachable to the back side of the movement (13) by means of screws (24) with the result that in order to separate the tourbillon module (20) from the movement (13) one only needs to unscrew the screws (24) and pull the tourbillon module (20) out of the movement (13).
9. Watch movement (13) characterised by an opening (18), which extends from the back of the movement (13) up to the dial side (15) such that the opening is suited to receive a tourbillon module according to one of the Claims 1 to 8.
10. Process of assembly and/or of adjusting a watch of the balance spring flying tourbillon type, characterized in that a tourbillon module (20) including a tourbillon collet (1), a balance bridge (2) a cannon (4), a ball bearing type bearing (5) a tourbillon bridge (6) forming an integral module supporting the regulatory organs, is designed to be totally separable from a movement (13), enabling an assembly of the said tourbillon module (20) by itself and/or an adjustment of the said module outside the movement (13).
11. Process of assembly according to Claim 10, characterized in that the tourbillon module (20) is inserted from the side of the movement (13) opposite from the dial side (15) into an opening (18) created in the movement (13) and that the tourbillon bridge (6) is fixed to the movement (13) on the said opposite side.

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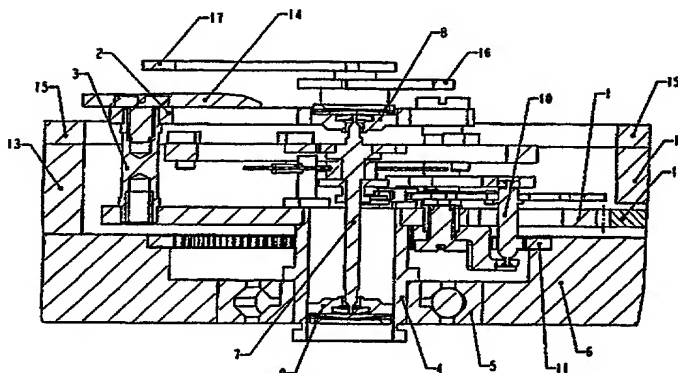
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(54) Title: MECHANICALLY REGULATED TIMEPIECE

(54) Titre: INDICATEUR DE TEMPS A REGULATION MECANIQUE



(57) Abstract: The invention concerns a timepiece with mainspring of the so-called fly tourbillon type, the tourbillon having a balance bridge (2) forming a cage with a collet (1) and a single protruding ball bearing (5) supporting said so-called fly tourbillon assembly. Said so-called fly tourbillon assembly is visible on the dial side (15) and is designed as an independent tourbillon module. Said tourbillon module is separable from the clockwork (13) by being detached on the rear side of the clockwork (13) and by being removed on that same side.

(57) Abrégé: L'invention concerne un indicateur de temps de type balancier-spirale a "tourbillon" dit volant, le tourbillon ayant un pont de balancier (2) formant cage avec une virole (1) et un palier unique en porte à faux à roulement à billes (5) supportant l'ensemble dudit "tourbillon" dit volant. L'ensemble dudit "tourbillon" dit volant est visible côté cadran (15) et est conçu comme un module tourbillon indépendant. Ce module tourbillon est séparable du mouvement (13) en le démontant du côté arrière du mouvement (13) et en le retirant du mouvement du même côté.

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